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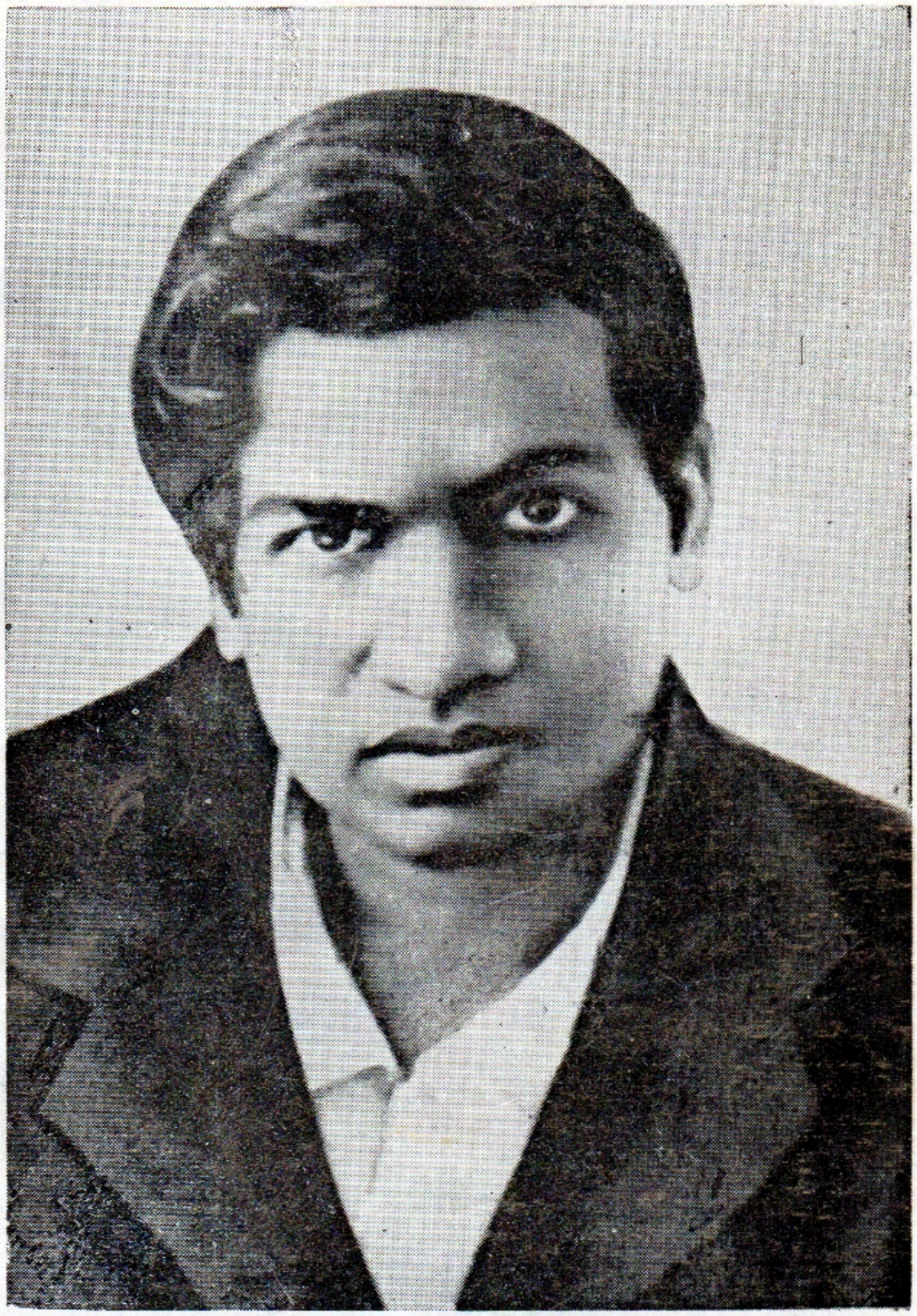

RAMANUJAN

(22-12-1887—26-4-1920)

" Well. I have done one thing you could never have done, and that is to have collaborated with both Littlewood and Ramanujan on something like equal terms. "

—HARDY

Suppose that we rate mathematicians on the basis of pure mathematical talent on a scale from 0 to 100, Hardy gave himself a score of 25, Littlewood 30, Hilbert 80 and Ramanujan 100.

—PAUL ERDÖS

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THEOREMS IN BANKING MATHEMATICS

by

M. NAGARAJA VARMA

Theorem A : If a principal P is to be paid back in equal instalments of y regularly after equal intervals of time t (t being a multiple of conversion period L), the balance B (f, Q) left after Q . f ($= n$) conversion periods is given by

$$B(f, Q) = P(1 + RL)^{Qf} - \frac{y(1 + RL)^{Qf} - 1}{(1 + RL)^{Q} - 1}$$

for all positive integers Q, $f > 0$, where $Q = \frac{t}{L}$. That is the instalment period t is Q times the conversion period L. f is the total number of instalments so that $Q.f = n$ conversion periods = total period of the loan or deposit, as the case may be. Note that $L < t$ in practical banking, that is the conversion period is less than instalment period.

Proof : Let B (1, Q), B (2, Q), ..., B (f, Q) be the balances left after 1, 2, 3, ... f instalment periods, each of size Q conversion periods. Obviously,

$B(1, Q) = P(1 + RL)^{Q} - y$ which can be written as

$$B(1, Q) = P(1 + RL)^{Q} - \frac{y[(1 + RL)^{Q} - 1)]}{[(1 + RL)^{Q} - 1]}$$

which proves the theorem for $f = 1$.

Substituting B (1, Q) for P, we get

$$B(2, Q) = B(1, Q)(1 + RL)^{Q} - \frac{y[(1 + RL)^{Q} - 1]}{[(1 + RL)^{Q} - 1]}$$

$$= P(1 + RL)^{2Q} - \frac{y[(1 + RL)^{Q} - 1]}{[(1 + RL)^{Q} - 1]}(1 + RL)^{Q} - \frac{y[(1 + RL)^{Q} - 1]}{[(1 + RL)^{Q} - 1]}$$

$$= P(1 + RL)^{2Q} - \frac{y[(1 + RL)^{Q} - 1]}{[(1 + RL)^{Q} - 1]}[(1 + RL)^{Q} + 1]$$

$$= P(1 + RL)^{2Q} - \frac{y[(1 + RL)^{2Q} - 1}{[(1 + RL)^{Q} - 1]}.$$

Hence, the theorem is true for $f = 2$. Let this theorem be true for $(f - 1)$ instalments.

Then,

$$B(f-1,\ Q) = P(1+RL)^{(f-1)Q} - \frac{y[(1+RL)^{(f-1)Q}-1]}{[(1+RL)^{Q}-1]}$$

Replacing P by B $(f-1,\ Q)$ in B $(1,\ Q)$, we get

$$B(f,\ Q) = P(1+RL)^{(f-1)Q}(1+RL)^{Q} - \frac{y[(1+RL)^{(f-1)Q}-1]}{[(1+RL)^{Q}-1]}(1+RL)^{Q} - \frac{y[(1+RL)^{Q}-1]}{[(1+RL)^{Q}-1]}$$

$$= P(1+RL)^{Qf} - \frac{[y(1+RL)^{(f-1)Q}-1)]}{[(1+RL)^{Q}-1]}(1+RL)^{Q} - \frac{y[(1+RL)^{Q}-1]}{[(1+RL)^{Q}-1]}$$

and thus

$$B(f,\ Q) = P(1+RL)^{Qf} - \frac{y[(1+RL)^{Qf}-1]}{[(1+RL)^{Q}-1]}.$$

As this is assumed to be true for $(f-1)$ instalments, it follows from Mathematical Induction that theorem holds good for f instalments. Since Q is also arbitrary, the theorem is true for all positive integers $Q, f > 0$.

Corollary : If a Principal is to be paid back in equal instalments with equal intervals of time between two successive instalments t (t being Q times the conversion period L) in f instalments so that the balance left B $(f,\ Q)$ is nil, then the rate of instalment is

$$y = \frac{P(1+RL)^{Qf}}{[(1+RL)^{Qf}-1]}[(1+RL)^{Q}-1].$$

Theorem B : If amounts each of value A are regularly deposited after equal time intervals of t (t being Q times the conversion period L), the total amount of principal and interest grown G $(f,\ Q)$ after f instalments is given by

$$G(f,\ Q) = \frac{A[(1+RL)^{Qf}-1]}{[(1+RL)^{Q}-1]}(1+RL)^{Q}.$$

Since, f and Q arbitrary are, the thorem is true for all positive integers f, $Q > 0$.

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